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UCRL-1210
Technology - Materials Testing Accelerator

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Contract No. W-7405-eng-48

CALIFORNIA RESEARCH & DEVELOPMENT COMPANY
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MTA MEETING ON ACCELERATOR TECHNOLOGY HELD MARCH 22, 1951

Russell H. Ball

Berkeley, California

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MINUTES OF MEETING OF MTA ACCELERATOR COMMITTEE
HELD MARCH 22, 1951

Present: UCRL: Alvarez, Farly, Gordon, Hernandez, Longacre, Moyer, Norton, Panofsky, Van Atta

CRDC: Chaffe, Fossati, Hildebrand, Maker, Myers

AEC: Ball

Hildebrand announced that the meetings of the accelerator group will be held each Thursday at 1:00 p.m. in the auditorium of Building 50. Whenever possible an agenda will be circulated in advance of the meeting. He said that the design and scheduling of construction of the drift tubes is proceeding, as are also the plot plan and design of the Mark II vessel. It is hoped to be able to begin the design of the Mark II drift tubes in the near future.

Gordon said that Longacre has prepared a preliminary table of drift tube dimensions and spacing, and Panofsky an estimate of flux requirements for a 1500-foot tank to produce 350-Mev deuterons. The geometries now envisioned for the Mark II drift tubes resemble initially the Mark I drift tube geometry with the exception of the drift tube apertures. The Mark II will start out with a 1/2 drift tube of 120-inch diameter and an aperture which is still undetermined. The first drift tube will have a $117\frac{1}{2}$-inch diameter and an aperture which is yet unknown. The total number of drift tubes required for Mark II has not yet been finally established. For drift tubes beyond No. 6 in Mark II, the design resembles that of the high-energy drift tubes of Mark I. They will have a 100-inch outside diameter and a 36-inch cylindrical bore. Panofsky said careful calculations are being carried out to determine the maximum allowable drift tube aperture since this will permit the greatest flexibility in future operation by permitting the acceleration of the maximum beam consistent with the other design parameters of the machine. The Mark II drift tubes are expected to be designed with removable bore sections at either end which can be removed should they become highly radioactive through bombardment by stray beam. Preliminary estimates on focusing requirements indicate that the power per magnet will be considerably less than for Mark I. This may relieve some of the design problems for the drift tube stem. Cooling requirements for the drift tube shell are not yet defined but they will probably be substantially more than for the Mark I drift tubes.

Those factors of drift tube design which would be affected by the proposed operation of Mark II CW but without an increased beam were discussed. Such operation will increase the rf heating by a factor of 4 or 5 but will not increase heating due to stray beam. The additional cooling required could be obtained either by reconnecting the cooling tubes from series to parallel or by permitting the drift tube shell to run with a 30° or 40° C rise in water temperature rather than the present design value of 10° C. Panofsky said the additional temperature rise of the drift tubes would increase their resistance by about 5% and increase the rf skin losses by 2 or 3 megawatts. It was decided to design the drift tube cooling for CW operation and to permit them to run with a 30° to 40° C rise in water temperature. It was decided to design the Mark II drift tubes with sufficient calrod heaters to permit them to be heated to not more than 300° C since Alvarez pointed out that present experimental estimates indicate that no improvement in secondary emission characteristics is noted between 250° and 800° C.

The electrical leads being provided in the drift tube supporting stems were discussed. These comprise one 20-KV lead for clearing fields. Two 4-KV coaxial cables and one 12-conductor assembly which contains 8 copper wires and 4 constantan wires. It was pointed out that polyethylene installed coax cannot be used because of the high temperature achieved within the drift tube during the bake-out. It was the recommendation that higher voltage leads be used for the Mark II drift tubes, provided no serious engineering difficulties are encountered. Gordon said that focusing magnets of the type designed for the No. 5 drift tube in Mark I will satisfy the requirements for all of the Mark II drift tubes for the remainder of the 1500 feet. This would permit the use of present drift tube designs for the remaining length of Mark II. Magnet designs can be chosen which vary the total weight of drift tube magnets in Mark II between 300 and 800 tons with corresponding power requirements between about $5\frac{1}{2}$ and 3 megawatts respectively. The present inclination is to minimize the capital cost and design the magnets for a total weight near 300 tons and a total power requirement of about $5\frac{1}{2}$ megawatts.

Alvarez emphasized the importance of preventing stray beam from hitting drift tube surfaces. Farly asked what could be done to turn off the injector when a fault occurs in view of the relatively long time required to propagate energy in the resonant cavity. Alvarez said that such a signal could be supplied through a circuit external to the injector.

Moyer discussed his calculations of shielding requirements for Mark II. Panofsky said that increasing the magnet focusing power will reduce the space between nodes and result in an increased divergence of the beam and asked if this would increase the shielding requirements. He said if the focusing power is increased by 40% the beam divergence will increase by $\sqrt{40}$. Moyer did not think this would have a significant effect on shielding requirements. Moyer's calculations assume that one mole per day of neutrons are liberated from the target, that they have a fission spectrum, and that the fraction escaping through the target hole is the ratio of the area of the hole to the area of the interior surface of the target. This gives 3 times 10^{16} neutrons per second per steradian going directly back into the accelerator. On this basis, if the shielding wall around the pipe from the accelerator to the target is assumed to be 40 feet from a center line of the beam then this shielding wall need not be any more than 5 feet thick at any point. The shielding required for the high-energy end of the accelerator itself is obtained by assuming that a few times 10^{14} neutrons actually enter the accelerator and are scattered by the first few drift tubes. This will require the side walls of the accelerator chamber to be 4 feet thick for a distance of approximately 80 feet back from the exit end. Moyer felt that although his calculations have neglected the effect of thermalized neutrons the shielding given above will be more than adequate for them as well. Alvarez again recommended the use of a deflecting magnet to bend the beam through 30° so as to prevent these neutrons from entering the accelerator itself.

Myers discussed in some detail the present design for the gap-splitters. As a result of considerable discussion it was recommended that the design be revised to permit the gap-splitters to remain as thin as possible at the circumference of the hole through them with the required volume change being accomplished by expanding them at the center or the outer edge. As a result of objections by Alvarez to the suggestion to heat them as high as 400°, it was decided to design the gap-splitters for heating only to 300° C.

Hildebrand said that engineering studies have been made of the cost of various pumping systems versus pump-down time. Assuming a reasonable figure for the value of operating time on Mark II, the pump-down times of the order of 30 to 40 hours are as short as can be justified. With steam-jet installation the pump-down time would be about 30 hours, while for Kinney pumps it would be about 42 hours. It was the consensus of the meeting that given time for proper design of the steam jet system and with competent operators the frequency of flashback would not be objectionable. However, since engineering time is not available for the necessary studies it was decided to proceed with Kinney pumps for the vacuum system on Mark II.

CR&D will make a rough estimate of the costs of providing water heating to the entire vessel, including reinforcing ribs and vacuum manifold as will be required if the entire vessel is to be heated to 125° C to accelerate outgassing. In the light of this cost, the "Review Meeting" will then be asked to decide whether this cost is justified since its value appears to be controversial.